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Organising flexible working spaces through techno-social networks

The case of door systems in hackerspaces

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Abstract

This paper should be interesting for any scholar who is curious about the role of innovation in configuring the relationship between society, organisations and ICT infrastructures. I expand a case study of a material artefact through its use to the description of an organisation which is contextualised in the wider structural transformations of capitalism. Therefore the methodological challenge is to study instances of social innovation in a way which can find material-organic connections between the micro-level ethnographic analysis and the macro-level sociological data. I ask **"How participation in hacker clubs is organised in response to changing social conditions, through conventions and technologies?"** Following the question, the three units of analysis to address are the changing conditions in society as a whole, the hacker clubs as organisations in the middle range, and finally the case study of techno-social means through which participation is organised. The empirically based theory of the network society stands in for the "changing social conditions", while "hacker clubs" are studied through the North European hackerspaces scene, and "organisation through conventions and technologies" is investigated through a case study of the door systems they employ. In the conclusion, hackerspaces appear as sites where privileged urban flexible labourers (ICT workers) organise themselves using technology and culture, according to the principles of the project order and the network organisation, amidst a contemporary capitalism which seeks to separate them in space and time. Such findings are contrasted with historical changes in regimes of work discipline and capital accumulation.

Keywords
hackers, digital labour, flexible work, techno-social networks, organisational sociology, sociology of use

1. Introduction

This paper should be interesting for any scholar who is curious about the role of innovation in configuring the relationship between society, organisations and ICT infrastructures. I expand a case study of a material artefact through its use to the description of an organisation which is contextualised in the wider structural transformations of capitalism. Therefore the methodological challenge is to study instances of social innovation in a way which can find material-organic connections between the micro-level ethnographic analysis and the macro-level sociological data. The main caveat in such an investigation is showing how larger structures are constructed and deconstructed through everyday interactions, rather than simply finding the right theories to apply to what is experienced on the ground. The following research question is thus asked mindful of these dangers.

How participation in hacker clubs[1] is organised in response to changing social conditions, through conventions and technologies? The three units of analysis to address in order to answer the research question are (a.) the changing conditions in society as a whole, (b.) the hacker clubs as organisations in the middle range, and finally (c.) the case study of techno-social means through which participation is organised. These units are concretised in the following sections on 'Context', 'Collectives' and 'Case'. In particular, the empirically based theory of the *network society* stands in for the "changing social conditions" (a.), while "hacker clubs" (b.) are studied through the *North European hackerspaces scene*,[2] and "organisation through conventions and technologies" (c.) is investigated through a case study of the *door systems* they employ. There are many other aspects of contemporary society, elements of hacker culture or cases of technocratic governance[3] which such an approach does not capture, but the idea is that concretisation of these categories reduces the initial complexity, allowing for both the increased practical viability of the research process and gains in the lucidity of the theoretical results.

[1] As explained later, *"hacker clubs"* is a more directly accessible synonym for Shared Machine Shops (SMSs): physical spaces for the expression of technological creativity and sociality. They include a growing taxonomy of organisations such as hacklabs, hackerspaces, Fab Labs, Makerspaces, media labs and innovation labs, incubators and accelerators, Men's Sheds and Tech Shops, etc.

[2] As explained later, *hackerspaces* are a genre of hacker clubs which distinguish themselves through their ethos and practices of self-organisation – a trait that makes them especially suitable to answer the research question.

[3] I use the term *technological governance* to denote shaping organisational structure and organisational culture by means of introducing technological artefacts.

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2. Context

Network society refers to the transformation of capitalism from the 1970s onward that led to fundamental changes in social conditions. Touraine (1969) and Bell (1973) theorise this phase of capitalism as *postindustrial*, a term which have been qualified many times by scholars in the last decades. More lately, Boutang (2011) discusses similar epochal changes as *cognitive capitalism*. For the moment, we focus on Castells's concept of *network economy* (2014) which draws on a host of earlier studies such as the ones mentioned here. All accounts agree on the general point that at the very least in the wealthier economies of the West, service sector and especially technology and knowledge intensive productive activities moved to the core of the economy, both in qualitative and quantitative terms. Automation based on micro-processors is one of the most pervasive change which profoundly affected all sectors. For the study of hackerspaces and technocratic governance it is crucial to realise that there is an engineering problem at the heart of these transformations.

Castells identifies the architecture of computer networks (not the computers themselves) as the decisive enabling and structuring factor in the transition to the network society. In the field of economy, competitiveness is based on the capacity to generate knowledge and process information effectively. The rise of the network enterprise follows, which results in the transformation of employment and labour: the world of work. The latter is the locus where large-scale changes enter into the life-world of hackers, and therefore the focus of this section.

Castells emphasises how actors "strategically reconfigure the geography of networks according to their interests" (2014 Chapter 2, p. 3). While multinational corporations employ only a small portion of the labour force, they are central to the economy. 260 million workers of the 3 billion global labour force work at 78.000 multinational corporations, yet produce 40% of global GDP and two thirds of international trade. At the same time, the informal economy is a more obscure but nonetheless important element. Computer networks enable many aspects – such as the finance sector which plays a structuring role – of the global economy to function in "real time" (Ibid. 16).

Therefore, even if technology professionals are not in leading positions, programmers and system administrators are essential since they put processors and networks to work. Their hold over technological expertise as well as the actual work of implementing managerial decisions means that they can in many cases influence decision makers through their advice, or alternatively, bend and even bypass managerial decisions while they are "executing" them. Technology workers are not only well-paid but have a relative autonomy on the labour market. More recently, the

Manning and Snowden leaks proved that employers can never be sure of the loyalty of their ICT workers, because in many important areas the "industrial reserve army" (Marx 2007, p. 699) of potential candidates for the job is not actually not very large (Cherney 2014). Ensmenger (2010) shows on the example of the introduction of computers in the United States that these two factors – computer engineers' hold over the exact implementation of managerial decisions due to their exclusive expertise coupled with the high demand for their labour – provide considerable leverage for them as a social group.

Access to know-how is essential since it is the main productive force for economic development. Productivity growth depends on technological and organisational innovation, two factors which according to Caldas, David, Ormanidhi (2005) have to go hand-in-hand in order to be effective. In this regard the hackerspaces are uniquely positioned since they put organisational innovation in the service of technological innovation. They are organised by hackers, for hackers, and their sole purpose is to facilitate hacking.

On the other hand, the network enterprise as a large social formation has some specific effects which are important for smaller players too. The project becomes the real operational unit, (Boltanski, Chiapello 2005, pp. 104–105) that needs specific kinds of humans and non-humans to operate. On the one hand, autonomous consultants who are flexible and self-programmable are key to the successful implementation of projects. In the terminology of Castells, *self-programmable labour* refers to workers who are not only highly educated but also fast learners and good in adapting to changing requirements. Their verso are *generic labourers* who can be easily replaced by similar workers elsewhere, or alternatively by machines. In this sense we can talk about self-programmable and programmed labour, and note that the more sophisticated part of such programming is often undertaken by self-programmable workers. It is evident that hackers fall in this latter category: they are programmers in the double sense of the world. Some of the specific cultural traits that set hackers apart from ICT workers in general are precisely the ones mentioned above that define the ideal type of self-programmable labour. As Dutton (1999) explores in detail, these dynamic business models which culminate in the *virtual organisation*[4] depend on the Internet, intranets, and other forms of computer networking. Therefore, as mentioned before, project consultants and technology workers are in high demand: in Western Europe and the USA of the mid-2000s, 20% of the required positions remained unoccupied.

[4] The *virtual organisation* is geographically distributed and characterised by flexible labour relations such as outsourcing and project contracts.

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The structural changes treated here often have detrimental effects which typically hit the relatively disadvantaged portions of this privileged sector. Faster technological cycles and ageist culture mean that older workers who find themselves on the job market have a hard time finding employment again, and in the absence of effective training schemes this can result in "pockets of long-term unemployment" (Quintana, Mora 2012). Unionisation plummets and consequentially the weaker workers lack any form of protection: collective bargaining power declines. Furthermore, even under such dramatic changes, the changes in the relations of production lag behind the more rapid changes in the forces of production, leading to specific problems which arise between economic organisations and workers.[5] Namely, workplace surveillance, new occupational pathologies from computerised work and institutional rigidity hamper both productivity and job creation.

Again, hackerspaces bring a model of the self-organisation of self-programmable programmers through organisational innovation which facilitates faster rates of technological innovation. In this model the network enterprise is stripped down to its bare bones (its essential elements) in a way that is idealised as *lean* in the management literature (Furr, Dyer, Christensen 2014; Ries 2011; Humble, Molesky, O'Reilly 2015). The difference between lean business organisation and hackerspaces is that the former creates value for customers and eventually shareholders, while the latter is the pure self-valorisation[6] of the workers. The notorious hacker phrase "for fun and profit" attests to that. As we will see, the orders of worth (Stark, Beunza, Girard, Lukács 2006) governing hackerspaces value two things first and foremost: the social well-being of members and technological experimentation – everything in the hackerspace is a mere corollary to those two points. For instance while pure self-valorisation often leads to spin-off companies emerging from the hackerspace, spin-offs are treated as just another aspect of life rather than a central fetish like in the lean startup culture.

Interestingly, despite the shortening cycles of innovation, the overall impact of automation is still less hours of work per worker, which can have either of two effects. One options is that while a significant portion of the labour force is out of work, the employed are doing more hours than before. The other option is that workers in general have to work fewer hours in order to attain more or less the same wage. Of course the net effect is a mixture of these two, but there seems to be a work time

[5] In this context *relations of production* refer to employment arrangements while *forces of production* refer to the machinery (Bottomore 2001, pp. 204–206).

[6] *Self-valorisation* means that workers produce value for themselves rather than for capital, enabling their development as a particular social group (Hardt, Virno 1996, p. 263).

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somewhere liberated by the introduction of new technologies. Peer production[7] models where "free time" is mobilised for value creation and often captured for capital accumulation is capitalism's answer to this problem. Consequently, the hackerspaces can be interpreted both as the reappropriation of free time by workers for socially useful work and on the contrary the recuperation of free time by capitalism for eventually turning such "free" work into labour.[8] Therefore in the final analysis the meaning of the hacker slogan "for fun and profit" is conflated: fund and profit become one.

Another aspect of the transformation can be analysed through the lenses of human geography. Despite early academic prophecies, working from home (telework) did not become a reality – instead, the multi-location of work places prevailed in the changing geography of the firm (Goddard, Gillespie 1986). In other words, not only the information processes but also the workers themselves became mobile and distributed.

Putting the two last points in the context of post-industrialism prepared the understanding of the hackerspaces as an urban phenomena. Postindustrial capitalism leaves in its wake vast unused industrial properties, often at the close edge of the city. At the same time, work gets dispersed across multiple locations and between multiple networks of people. However, people still need to be rooted somewhere (Putman 2000) and the hackerspaces provide a matrix of possibilities to accommodate these dispersed networking needs: spaces where flexible workers can band together. I argue that the hackerspaces are a privileged geographical location suited for such multi-located workers to pursue digital labour.

These geographical changes are complemented by changes in work patterns. In general hackerspace members can be divided into three groups in terms of work patterns: the highly educated unemployed who have in some sense too much time, middle class information workers with a bit of time and money on their hands, and elite high-tech workers whose case is the most complicated because they have more power to reconfigure labour relations according to their personal preferences. Of the latter groups, some spend only a few days earning a considerable wage, and dedicate the rest to the hackerspace, while on the other end of the spectrum others dedicate themselves to their professional carriers entirely, so that they have no time to actually go to the hackerspace. Even so, all of them play distinctive roles in the organisation and upkeep of hacker clubs. As evident from this description, all are increasingly

[7] Peer production is a mode of massively distributed, technologically mediated, open collaboration towards a common goal, argued to be enabled by falling transaction costs of cooperation (Benkler 2006; Shirky 2008).

[8] See Terranova (2000) on the former and Smith (2014) on the latter.

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flexible in their own ways, and they have to negotiate these flexibilities in their club. That's why hackerspaces are theorised here as flexible working places.

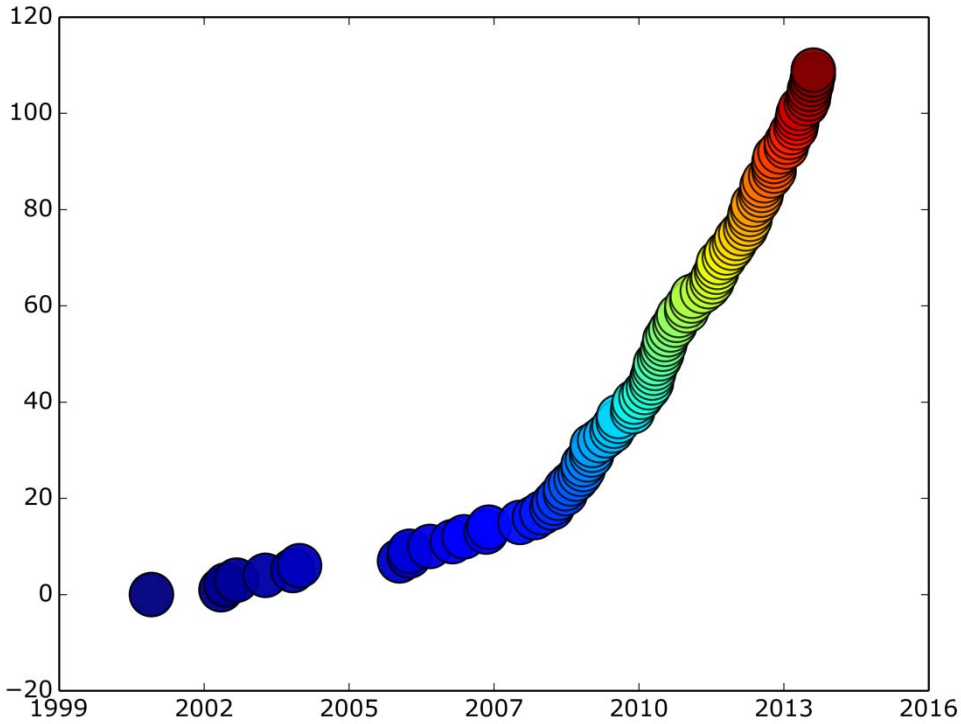

Figure 1. Hackerspace domain registrations plotted from the list on hackerspaces.org. Registration times are from the whois database.

3. Collective

Hackerspaces – hacker clubs with physical premises – constituted the second wave of open, collaborative technology spaces like hacklabs,[9] Fab Labs, makerspaces, media labs, etc. These are treated in a special issue of the Journal of Peer Production under the general rubric of *Shared Machine Shops* (Troxler, Maxigas 2014). Technologically minded people use them to come together, socialise, work on projects and produce/share knowledge and infrastructure. The Design Patterns outlining the

[9] Which were the first wave, documented in Maxigas (2012) and updated with new results in Maxigas (2014a).

basics of setting up a hackerspace have been defined by Ohlig, Weiler (2007) – a presentation that can be seen as one of the starting points of the movement. Since 2007 hackerspaces have spread virally, reaching almost thousand registered establishments on hackerspaces.org. This exponential growth can be clearly seen looking at the registration dates of hackerspace websites, plotted in Figure 1. While new generations of *Shared Machine Shops* are introduced into the ecosystem (starting with Fab Labs), there is currently no sign of this tendency slowing down.

Hackerspaces operate on the basis of membership fees which is spent on rent, upkeep and equipment. Key holding members have 24 hour access to the space and most hackerspaces are open to the public when there is at least one member on site. However, there is no fixed opening time beyond the events announced on the website. Even though membership comes with social status and a key, in most hackerspaces it is not a necessary condition for attendance. Most hackerspaces seek to ensure that members and non-members have almost the same possibilities. The door systems are specifically designed to make it easy for non-key-holders to make use of the hackerspace without putting extra responsibilities on official members, responsibilities such as opening the space at regular intervals.

The political economy of hackerspaces is closely tied to the political economy of their membership. In Maxigas (2014b) I give a detailed analysis of roles played by typical hackerspace members, grouped according to their employment status, which is summarised briefly here. Some hackerspaces are regularly visited by homeless people who are recognised as “chess players” at least in the Metalab (Vienna, Austria), Mama (Zagreb, Serbia) and Noisebridge (San Francisco, USA) hackerspaces. Especially in poor countries, members without a regular job spend most time in the hackerspace. They often clean, build and maintain infrastructures or work on flagship project, but sometimes their contribution is merely to keep the space open, which is important in its own right. One member in Budapest told me that he has no comfortable desk at home and that is one reason why he hangs out in the hackerspace. Freelancers flock to hackerspaces to find an inspiring environment with a strong network of technology professionals. Boltanski and Chiapello (2005, pp. 104–105) emphasises that the project order as the basis of contemporary economic activity is only viable where actors can make many relevant connections and reconfigure them informally – conditions which hackerspaces satisfy eminently. It can be argued that hackerspaces are an instance of self-organisation by flexible and precarious labourers and non-labourers which aims to satisfy their particular needs in the fabric of urban space, adapting to the dislocation and deterritorialisation of labour as well as its disappearance (e.g. temporary employment and unemployment).

Then there is a sizeable group of members who have regular “nine to five” day jobs. They often contribute the bulk of membership fees which is crucial for the financial

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sustainability of the hackerspace organisational model. They come to the hackerspace after work and stay for a few hours, or alternatively attend weekend sessions. They can be divided into three subgroups according to their activities in the hackerspace. In the TOG hackerspace in Dublin, Ireland – a city ridden with software developers and system administrators since tax regulations attracted Internet monopolies like Facebook – many members come to do something else then they do at work. Software and systems people arrive without their laptops (which is otherwise unusual in hackerspaces) and spend time building hardware, developing robotics projects and picking locks. On the contrary, unsatisfied workers in many other hackerspaces come to do *the same thing* they do at work: writing software code and building informatics systems. Yet, they do it *differently*: fed up with overly complicated, slow and unstable "enterprise solutions" or needlessly slow, verbose and complicated programming languages, both imposed by their bosses, they write free software in interesting languages and design distributed systems of elegant simplicity. The third group attends the hackerspace as a traditional club: in order to socialise with like minded individuals.

All the networking yields its return too, so that some hackerspaces spawn spin-off companies which capitalise on the inventions made by members. Hackers become entrepreneurs as in the case of MakerBot Industries – a major open source company pioneering 3D printers – which started at New York City Resistor and later bought by the NASDAQ company Stratasys, Ltd. (Söderberg 2014). However, this is only the tip of the iceberg. Local companies were started around similar ideas by members of hackerspaces in Sao Paolo, London and Vienna (just to speak of my own field work experiences). In the latter cases the employees and founders stayed affiliated members and active participants in the hackerspace and the company supports the space in various ways from in-kind donations through knowledge transfer to cash. A network of successful companies seems crucial for the sustainability of most hackerspaces.

Finally, in the top of the tier there are geniuses and ghost members. Geniuses are good enough that they can earn a living by working only a few days a week, or sometimes a month, and dedicate most of their time to their hobbies, like a hackerspace. While usually they specialise in a specific area, they are an important resource to the hackerspace and usually spend quite some time in there. Ghost members on the other hand never appear, only participating on the mailing lists and sometimes the chat rooms. Even though they are not usually building anything or contributing to social life in a big way, they can be still important supporters. These people typically have a demanding job, and/or a demanding family, so that they cannot do much in the way of hacking, yet find it important to have a hackerspace in their town. For instance in Budapest one such ghost member financed the three months' deposit when the space had to move urgently.

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In conclusion, hackerspace memberships are quite diverse in terms of employment backgrounds and financial situations, comprising anything from homeless people to Fortune 500 managers. Three corollaries are important to note in terms of the subsequent analysis. First, diversity of employment backgrounds leads to diversity of timetables, and diversity of timetables leads to stochastic hackerspace opening patterns. Second, each group contributes to the collective in their own way, socially, technologically and financially. Third, the hackerspace is tied in with the network enterprise and (thus) has an important social function, which is to be preserved in the face of these random variables. As shown in the next section which comprises the case study, these interdependencies orientate the need for automated door systems in ways distinct to the culture of the hackerspaces themselves.

4. Case

To recap, hackerspace opening times are stochastic and sporadic. To deal with this problem, hackerspaces use an alternative system of signalling to see if and when somebody opened the hackerspace. The physical interface is usually a spectacular button on the internal wall near the door, which sends a signal to a tailor made electronic device. The device changes an image on the website which says OPEN or CLOSED. This way potential visitors can check in real time if the hackerspace is open.

Hackers typically complement this simple contraption with additional interfaces, which work through an API[10] that enables checking the space state programmatically. iPhone applications, interactive maps of hackerspaces around the world, chat bots which announce the state on the channel of the hackerspace, docklets for popular operating systems and many other inventions use these APIs for the space state. Many hackerspaces plot open time and display a “heat map” on their website. Door systems are continually elaborated by members. In older hackerspaces they often control the actual lock on the door, turn lights on and off automatically, measure the temperature in the room, the number of wireless connections, etc. During the last years door systems have become part and parcel of the typical hackerspace. The SpaceAPI initiative which unifies the interfaces of door systems through an open standard contributed to increased networking between hackerspaces.[11]

[10] Application Programming Interface: a standard way to expose internal functionality of technological artefacts so third parties can incorporate them into their systems.

[11] See http://spaceapi.net/

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Therefore the study of door systems warrants attention as an interesting case of socio-technical innovation emerging from a particular milieu. Socially, it can be understood as the cybernetic reimagination of opening time,[12] while technically it is a good example of a homebrew device developed to address particular community needs. Such needs reflect wider and more general changes in work patterns amongst urban technology professionals, the flexibilisation of labour and the particular problematics of self-employed, often precarious creative workers. Thus taken as a case, the door systems are a prime example of the configuration of the socio-technical nexus in grassroots research and development spaces and the way it sits in the surrounding social fabric.

5. Methods and data

I used three different qualitative data collection methods. Firstly, participative observation spanning more than a months' time in London (HackSpace), Amsterdam (Technologia Incognita) and Budapest (H.A.C.K.). Secondly, field surveys of at least 6 hours in 9 other hackerspaces (The Netherlands, Germany and Eastern Europe) in order to contextualise the proper ethnographic data. Thirdly, desktop research on door systems comprising an in-depth look at 27 additional implementations based on their online documentation on hackerspace wikis. In all these efforts I concentrated on how door systems are used to connect machines and people together around a single hackerspace as well as between hackerspaces, and how these particular ways can be understood in the context of wider societal changes.

6. Discussion

Hackerspaces differ from other *Shared Machine Shops (SMSs)* like co-working spaces and profit-oriented Fab Labs in that their open organisational architecture allows for much more diversity of social backgrounds. The various groups of people attracted to hackerspaces play different roles in the organisation, yet they are all

[12] Cybernetics is a school of scientific thought and practice that conceptualises its problems in terms of systems governed by feedback loops. For primary literature see Wiener (1948), for secondary literature Dupuy (2000). Tiqqun (2012) suggests that cybernetics became an overarching ideology of the second part of the twentieth century.

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affected by the precarisation and flexibilisation of digital labour and respond to them collectively through their practices of self-organisation. The common thread in their responses is that hackerspaces enable them to work more effectively, learn more quickly and have much more fun than pursuing their various activities individually or in a more institutionalised context. That is not to argue that the hackerspace is an ideal world of reconstituted communities. As Sophie Toupin shows from an intersectional feminist perspective, social exclusion is a very real factor in hackerspaces, manifesting in manifold social conflicts and engendering resistance, including the founding of alternative initiatives driven by women and transgender participants who decide to take a separatist stand (2013, 2014). Furthermore, as the analysis below shows, the functionality of door systems mediates social control and workers' discipline based on feedback loops as much as workers' control about the production process.

The self-organisation of labour between Collective and Context

I relate my observations to Berardi, Jacquemet, Vitali (2009) where he writes about his experience of organising precarious creative workers in Northern Italy. Under the proliferating existential conditions of what he calls cyberspace and cybertime – the fluidity of spatial and temporal rootedness – the organisation of labour faces different problems than at the time of the classic workers' movement. The specific challenge Bifo encountered in this new context is establishing the basic conditions for practical solidarity: shared time and space. In contrast to factory workers who have the shop-floor as the baseline of class formation, the people that he is working with are so dispersed that it is difficult to even to find a common place and time where they can meet in their bodies and be together. **This is the question raised by the political-economical condition of the flexibilisation of labour which the hackerspaces answer. And they answer it through a specific configuration of human and non-human actors, the unfinished architecture of a network organisation which is less a parallel, more an antidote to the network enterprise.**

There are several social groups which are affected by the precarisation and flexibilisation of labour. However, not all of them can maintain sustainable social spaces for their own use without hegemonic institutional support or without accepting illegality and the vulnerabilities which come with it. Hackerspace members are in a special position because they are privileged economically as highly skilled IT workers and *at the same time* empowered culturally by way of the decades old hacker tradition. I propose to call such a specific economic privilege coupled with a particular in-bred cultural tradition the *relative autonomy* of this social group. They are dependent on the

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market for resources, but they can decide where to invest them. Furthermore, due to their expertise, they are able to valorise limited resources to greater effect than some other social groups and organisations. The analysis of the political economy of hackerspaces and their members show that *relative autonomy* enables the establishment of techno-social spaces which can accommodate a wide number of uses and a variety of participants with differing backgrounds, though the claims of universality they make remains more of a vision than a reality, as the gender example exposes. In essence, the primary product of hackerspaces is a specific form of self-organised and technologically mediated (male chauvinistic) network sociality.

Beyond socialisation, hackerspaces are sites of grassroots technology research and development. I am trying to qualify this assertion in multiple ways by working through the concept of *unfinished artefacts*. Building on the results about the social composition of the hackerspace membership I now ask what roles small scale electronic artefacts play in the network socialities detailed above. Therefore the following pages shift the focus of the discussion from the connection between Context and Collective to how the Collective is implicated in the Case.

Unfinished artefacts between Case and Collective

Like network enterprises, hackerspaces are built around the idea of *projects*. It is quite astounding how the *project order* described by Boltanski and Chiapello (2005) is hard wired into the way hackerspaces are organised, and how consistent this order is across various hackerspaces. Work is traditionally coordinated through the combination of the following information and communication technologies: a wiki, mailing list and chat room (from least to most ephemeral). The most prominent section of the wiki is always a “projects” area with an overview of who is working on what, as well as the stage and progress of the project. Projects are usually as concrete as “build an OpenPilot drone”, but they can be abstract too, like “motivate people to clean more often”. From this it is already apparent that participant hackers set for themselves can be the creation of a technological object or the production of a change in social relations – the case study focuses on a project which involves both.

In the spirit of open collaboration which is the hallmark of peer production, project development is undertaken through public documentation. Therefore the information available to the general public on the website is often the same information which members use as the internal documentation for the everyday work on the prototype. This is complemented by the *open door policy* of the space: anybody can walk through the door and contribute to the initiative. Interestingly, the initial account of technologically mediated mass online collaboration given by Shirky (2008) also singles

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out the wiki as the tool of choice for supporting such a social dynamic. Technically, the wiki engine software used by hackerspaces is often the same which powers Wikipedia.

Conceptually, hackerspaces are at the forefront of transformations in contemporary cognitive capitalism. As firms are present on the market through their products, hackerspaces participate in the scene through their projects. While the product is characterised by having an exchange value which enables it to circulate on the market, the project circulates in knowledge networks without exchange value. Contemporary mass self-communication networks outperform the market as distribution channels, so that projects can spread faster and further then products. Partly because of these factors in off-the-shelf political economy, but partly because of the political economy of their cultural valuation, they have more freedom than products in the sense of what can happen to them and what kind of meanings they can take on. I am convinced that the fact that the projects of hackerspaces are essentially *counter-productive* in the sense of lacking an exchange value is still under-appreciated. This observation has to be considered against the universal background of all artefacts – human created objects – in the world. The product is the universal form of artefacts in capitalism, especially small scale electronic artefacts – "consumer electronics". It takes much culture for these open hardware experiments to escape market circulation. Of course *successful* projects escape the ghetto in the way music and musicians, styles and celebrities make their way to the limelight: picked up by managers and transformed into mainstream products. But the vast majority are not successful in the commercial sense, nor aim to be. Moreover, commercialisation is not a straightforward or unconflictual process.

Projects often have built-in functional elements which seek to counter commercialisation (Maxigas 2014c). Contrary to the naive approach to open hardware, the most important of these is not the licence but the documentation. Whatever the licence, the documentation demonstrates prior art and therefore it can potentially be used to attack patent applications. Hardware solutions cannot be licensed in the same way as software, so that patents are the main legal instrument of ensuring privileged access to their production. Software patents are recognised in the United States but not in Europe. In fact the European directive on software patents was dropped in response to massively distributed public protests in which the hackerspaces and their members took an active role. These differences notwithstanding, the free software commandment of "publish early, publish often" is not simply a commitment to the community but also the first step against commercialisation. The practice of using a wiki to develop and simultaneously document projects has to be understood in such a context.

Culturally, the dividing line between products and projects is even more subtle. Projects usually manifest themselves as small scale electronic artefacts which one can

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hold in hand, and use for a more or less recognised functional purpose. However, they are usually evaluated as a process rather than as a product – one of the reasons I prefer to call them *unfinished artefacts* (2014c). Such evaluation points beyond what is traditionally understood as use value. A small catalogue is sufficient to demonstrate these criteria. A good project uses cheap off-the-shelf parts. It sports a simple yet elegant design which is easy to understand. The plastic box which became the hallmark of consumer electronics is often missing, laying parts bare to the eye of the beholder. These factors lower the barrier for *reproducability* which is fundamental to the value of the project. Alternatively, off-the-shelf parts can be replaced by components "found" in the environment, so that the project presents a compelling case of restoring their use value. Furthermore, a good project is not a routine undertaking but enables its maker to move out of her comfort zone to learn new skills and gain new insights. For this reason it does not have to be innovative. Reinventing the wheel without prescience of prior art is considered a mistake by hackers, but imitation is totally legitimate. These are evidently *educational* considerations. Due to limitations imposed by the environment, the imitation is adapted to the specific circumstances anyway, so that its value comes from how it sits in the local techno-social context. A project can also excel in *engineering aesthetics*: surprisingly clever solutions and strikingly elegant design decisions make a hack in the highest sense. Hackers appreciate artefacts which achieve complex behaviours using simple rules, thus connecting engineering aesthetics to reproducability. Furthermore, the self-recognition of hackers in the hacks elevates the *cultural value* of the project. As with any subculture, certain signs have a special affective and cognitive meaning which is greatly appreciated. Putting aesthetics and self-recognition together, Coleman (2012) rightly argues that in-jokes are the heart and soul of the hacker scene. Last but not least, there is what is conventionally called use value, which determines how useful the given artifact is as a *practical tool*. Ultimately, however, the simple fact that somebody wants to do them is enough justification and legitimation to work on a project in the hackerspace – projects are not formally evaluated. In sum, hackerspace projects combine three functions that are otherwise strictly separated by the modern institutional grid: *education, research and production*.

Ur door system

Particular projects are structured by the patterns laid out above, but here we deal with one which also structures these patterns more than other projects. Door systems can be thought of as the project par excellence of hackerspaces. They also form the physical, virtual and logical opening of the hackerspace through which one enters this world. Door systems mark the passage from culture to subculture.

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I have not been able to map the prehistory of door systems, which may be lost in obscurity. The Ur door system must have been the entry gate at the main entrance of the c-base hackerspace in Berlin. Informants mention c-base as "the mother of all hackerspaces" (Bre, Astera 2008) or at least one of the first ones in Europe (1995). However, hackerspaces as a movement of proliferating hacker clubs only took off around 2007, a turning point being Ohlig, Weiler (2007). Hackerspaces in North, West and East Europe quickly reached a mass and consistency which shows that the social conditions were ripe.[13] The door systems they use are very different from the entry machine at c-base, yet perform similar gestures. The door system brings together *open participation*, which is supposed to be universal; *technological expertise*, which is supposed to be inventive; *network sociality*, which connects the previous two. The criteria already defined as the ethos of open hardware apply to door systems.

Door systems as rites of passage

Over the years, door systems have become the *hello world* project of hackerspaces. *Hello world* is a traditional test program which prints out "hello world", the first one coders write when they learn a new programming language.[14] Similarly, the door system is often one of the first projects built in a nascent hackerspace. It can be considered equivalent to *hello world* in three different ways. Firstly, it proves that the participants are hardware hackers and they can build simple electronics projects in their hackerspace. Second, when a member enters the space and turns on the door system, it is a performative act which announces that the hackerspace is open: practically and symbolically, the hackerspace only exists from that moment. Third, door system implementations usually include the SpaceAPI, a protocol which announces the existence and the status of this hackerspace to all the other hackerspaces in the world. In sum, building the door system for the new hackerspace is testing the infrastructure, equipment and knowledge pooled together; setting up basic coordination tools and ritualistic significances; and finally, symbolically and practically integrating into the hackerspaces scene. Thus, the door system is an essential element in *becoming a hackerspace*.

While each door system is implemented from scratch in very different ways, the SpaceAPI allows them to behave uniformly towards each other. The differences in implementation allow for each hackerspace to express itself in a unique way according

[13] South Europe followed a somewhat different trajectory from the beginning of hacker culture, where at least in Italy and Spain a more political hacker scene was already organised since the 1990s through yearly *hackmeetings*.

[14] Source code for printing "hello world" in 295 languages, including Jacquard Loom punch cards: http://rosettacode.org/mw/index.php?title=Hello_world/Text&oldid=194460

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to locally available talents and tools, but the shared protocol ensures interoperability — like a lingua franca. The SpaceAPI is not a program but a specification about how each program should work. Since many hackers are programmers, they can implement the protocol as they see fit, in the same way that they build the haptic and electronic interfaces to their door systems themselves.

Door systems diversity

The door system at BitLair, Amersfoort (Netherlands) is one of the few which does not sport a button or sensor on the front door. The decision about whether the space is open or closed in made by the main wireless router fixed on the ceiling of the wooden barn where the hackerspace resides. It triggers the opening sequence after ten minutes when it senses that a laptop of a registered member is connected. When such automatic behaviour is not desirable, members set the state manually by logging in to the router and turning off the "autopilot". This feature ensures that members are still in control. I understand that such feeling of *user controlled technology* is one of the prime reasons why most other hackerspaces decide to create a manual button (i.e. a haptic interface) for the door system instead of an automatic solution like in Amersfoort. The door system keeps track of the number of connections through the day and Bitlair publishes the statistics. Thus the activity in the space is visualised to online audiences. More connections for longer times means more members and more hacking, which makes a more valuable hackerspace. In fact some members go to the hackerspace to pursue what they would otherwise do elsewhere – just to keep the space open, the activities up and the statistics rolling.

Hackers from BitLair contribute to the hackerspaces scene by building network infrastructure for the Dutch hacker camps, which are the largest and most important in Europe, attracting more than 4000 visitors lately. Members made important contributions to the NOC (Network Operations Centre) and the LOC (Lights Operation Centre) during the last camp (OHM2013).[15] The former group took care of installing Internet infrastructure on the camping site, while the latter group was responsible for controlling the colours of public lighting programmatically.

The barn of Bitlair came with an electronic alarm system installed, but it was not possible to turn it on and off from the Internet. Members reverse engineered the proprietary protocol to remote control the alarm system, circumventing this limitation.

[15] "We've been extremely busy organising OHM2013. There will be plenty of content after OHM2013 is done as Bitlair members together with other members of Team:LOC (Light Operations Centre) have created an awesome lighting system. Other Bitlair members are in Team:NOC (Network Operations Centre), and have been busy planning, configuring and splicing fibre-optic cables." – https://bitlair.nl/quick-update/

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They published the results and forced the vendor of the alarm system – by going through the Dutch secret service – to upgrade the protocol to a more secure one based on the hackers' suggestions. Now the door system of Bitlair can turn the alarm on and off automatically, according to whether the hackers are around, and report the alarm state and events on the chat channel which is the virtual lobby of the members (Hofman 2013).

From these descriptions it is evident that some Bitlair members are very good in network security, and their particular implementation of the door system is deeply implicated in the expression of this passion and the exercise of such expertise.

Another instance is the door system at Technologia Incognita, the Amsterdam hackerspace. As they reported in the Hackerspaces Exchange workshop organised by Becha (2012), they started without much experience in electronics, and were eager to show off their progress. Indeed, the TechInc logo is not only shaped as a steering wheel for boats but at the same time it is a functional electronic circuit design. Moreover, it demonstrates a trick of the trade about how to distribute electricity to multiple directions at once. Newcomers to the hackerspace can pay a nominal fee to get the necessary basic parts and solder it together to light up a ring of LEDs around the logo – a good exercise for beginners. Now, the door system switch is a big red button which lights up exactly this logo, similar to the "ON AIR" signs seen above radio studio doors. The message is the same: the radio is transmitting or the hackerspace is open. It is easy to see that while the Bitlair door system is built around the idea of hacking serious network protocols, the TechInc door system is about learning electronics.

Not far from Amersfoort is Hack#42, the hackerspace in Arnhem. It is definitely the largest hackerspace in the Netherlands and a big one according to the European standards too. It is located in a leftover WWII radar control centre built to look like the German cottages on the other side of the border. It is one of several similar buildings at the edge of town – most members arrive with a car or bicycle from the surrounding town or the city centre. Two large stories and an attic gives ample space to house all kinds of facilities members can amuse themselves with. To list only the antique collections, there is a computer museum, a compendium of typewriters and calculators, a stock of vintage cameras and a refuge for defunct projectors – each occupying their own rooms. The management of such a large space easily becomes a challenge, especially given given the clientele. A common hackerspace rule displayed on the walls in more than one space I visited is "don't be on fire" – a very apt one for Arnhem, where they already had the classic accident when the laser cutter cuts itself in two.

Fortunately, one member who takes care of the door system is an electrical engineer who was up to the challenge of securing the hackerspace. The most important problem was to take care that most electric sockets are deactivated when

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members leave, especially because as mentioned before the hackerspace is not in a central location in the city, so coming in to deal with emergencies is a real hustle. Therefore, flipping the door system switch turns on/off a number of sockets – virtually everything except safety lighting, core networking, the fridge and the aquarium. Another problem is to make sure nobody is left in the building when members leave, which is done through an automatic announcement over the legacy megaphone network in the building and the chat channel on the Internet. Therefore, the Hack#42 door system is about infrastructure management and safety – an expression of this hackerspaces' unique characteristics and requirements.

Door systems consistency

The previous three examples were destined to demonstrate the range of differences found in the implementations, in order to flesh out the argument that despite the consistency of practices around door systems, each hackerspace solves the problem differently depending on the local context. Having established this point it is time to return to the survey of how door systems integrate hackerspaces into a consistent scene through material infrastructures. The SpaceAPI is an information source, but it would not do anything visible if there would not be applications which use the data that it makes available. There are dozens of such applications, from iPhone apps which show the status of your favourite hackerspace and guide you through the map to reach the door, to status bar docklets which alert the user when a hackerspace nearby opens its doors. Almost all hackerspaces have a chat bot (an automated program impersonating a user on the chat channel) that announces opening, closing and other events of the given hackerspace. However, perhaps the best example for the cohesive magic of the SpaceAPI is the Hackerspaces Wall,[16] where one can browse the database of hackerspaces laid out on a map, and follow in real time how many in the world are open or closed. The Wall includes Twitter post frequencies too, as another indicator of the hackerspaces' activity. These features are obviously as much symbolic as they are practical. They show the unity of hackerspaces and allow hackers to discover hackerspaces around them or at the places where travel. There are many hackerspaces which are registered but not actually active, which makes the Wall a very useful resource to asses the activity and availability of particular hackerspaces.

However, such integration does not stop at the level of a symbolic unity. **Since hackers are prone to encode social relationships on material, logical and functional surfaces, symbolic unity quickly slips to a functional unity which**

[16] Now seems to be defunct, previously available at http://hackerspaces.me/

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becomes a de facto constituting factor in determining group membership. SpaceFED is a distributed authentication infrastructure similar to the eduroam network which ensures interoperability of wireless access between universities. With eduroam, a student who has an account for using the wireless in his university can use the same credentials in other universities because the user databases are federated. SpaceFED provides the same service across hackerspaces. According to the list of participating projects,[17] if a person joins Technologia Incognita in Amsterdam, they can use the same username and password to go online in Leipzig's Sublab in Germany. In this case the username and password is sent to the local authentication server of Sublab. A portion of the username includes a domain which shows that this is not a member of the local space. Noting this, the local server proxies the request to a central server which crucially does not hold personal information but queries the appropriate hackerspaces' own authentication servers in turn to receive an answer. If the foreign hackerspace – say Technologia Incognita – claims the user as its own, the confirmation is passed back to the Sublab network through the central server and the member is granted access to the protected wireless network. Hence the technical setup closely parallels and indeed, constructs the structure of the scene, which is build on solidarity between hackerspaces negotiated through a global, shared infrastructure. A member of any hackerspaces is warmly welcome in other hackerspaces, but here it is not only a social convention but a cold technical fact.

Moreover, in small and large events where hackers gather it is also possible to find SpaceFED enabled access points. This is extremely useful because the stability and security of wireless networks at such events is always a nagging problem: participants are eager to hack each others' computers and connections and to test the limits of the infrastructure. The sheer number of participants means that sometimes there are just too many people connected for one more device to go on the network. Under such circumstances it is great to have a smaller network restricted to users who are hackerspaces members, and to rely on the superior security design of SpaceFED. *Therefore providing a SpaceFED network at hacker conventions is another show of practical solidarity between hacker clubs that contributes to a common identity and manifests their unity through material practices.*

As time goes by, the system evolves to another level: a new initiative being discussed between hackerspaces right now is to use the same authentication system to operate electronic locks in close integration with local door system implementations. Members would hold a chip card or use a mobile device to provide their credentials at the entrance, which would unlock the physical door of the hackerspace. The initiative emphasises and instrumentalises the implicit gesture of hospitality between spaces:

[17] See https://spacefed.net/wiki/index.php/Who/Spacenet/Spaces

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"please feel at home". Curiously, it also inscribes – in the sense of Akrich (1992) – into material infrastructures a famous social practice which dates back to years. Members of Noisebridge (the San Francisco hackerspace) were known to distribute physical keys to the audience at hacker meetings with the slogan "Our doors are always open to you". It fitted into the image of the space as a welcoming and open environment even compared to hackerspace standards (together with their motto "Be excellent to each other!").

Thus, door systems integrate hackerspaces as organisations on the scene level, which incorporates all hackerspaces, while they also integrate individuals as members on the organisational level of the single hackerspace. They stand at the intersection of daily life (a member entering the space) and the evolution of the scene (a hackerspace entering the scene). In this capacity they *negotiate the problems which abound around the precarisation and flexibilisation of space and time*.

Door systems as time clocks and social innovation

In the final analysis, the flexible coordination of hackers' work and social life through the material infrastructure provided by the door systems can be understood as a piece of techno-social innovation: the reinvention of opening times and time clocks. In his seminal work (1963) and a programmatic later paper (1967), E.P. Thompson described time keeping technologies like the clock in general, and the time clock in particular as instrumental to the social construction of work discipline, and an indispensable element of the factory regime in the classic phase of capitalism. The cottage industry blended craftsmanship work in the everyday routine of family, friends and other helping hands. In contrast, the factory required the strict regulation of the space and time of work in order to make mass production feasible, increase effectiveness and maintain predictability – all key factors for competitiveness. Indeed, workers evidently understood the role of time keeping in the factory regime, since they specifically targeted clocks during revolts, putting them out of order. In the heyday of industrial capitalism, the time clock stood at the gateway of each factory where workers would have to punch their cards and later display them on payday. Since they sold their labour power by the hour, the time clock measured how much they sold and thus how much money they would get for their work. Indeed, such system would be actually an improvement from piece work, which constituted an earlier and lower category of employment. Piece work jobs were payed after the number of products turned out, in the style of the cottage industry regime.

Fixed monthly salaries, and the obsolescence of time clocks was characteristic of what Frayssé (2013) calls "Fordism 2": a middle period whose guiding paradigm was regulation instead of efficiency, or better, the regulation of efficiency. Resistance of the

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working class resulted in a historical compromise known today as the model of the welfare state. However, this was partly financed through debt, and became increasingly infeasible economically, while at the same time its political raison d'être eroded. The 1970s marked the beginning of the restructuration of the production regime. Frayssé (2013) largely agrees with Boltanski and Chiapello (2005) that the ethos embedded in these transformations can be formulated as "*freedom*", even though the latter authors use the leftist phrasing instead of the liberal one: "*autonomy*". The general conclusion is that the third phase is about the self-regulation of efficiency, where the limits of capitalism are internal and thus work discipline is also internalised. Ironically, in terms of work discipline established through the regulation of time, this period marks a return to piece work and the cottage industry, with the work of "self-programmable" (Castells 2014) independent consultants on one end of the spectrum and the disposable "general labour" of Amazon Turks (Gray 2013) at the other.

Of course, the actual landscape is more complicated because phases of capitalism do not merely follow each other. Since it is a historical process, at least in terms of the work regime there is stratification happening. Namely, basic methods for the establishment of work discipline remain to be found, but they are distributed according to the level of privilege different groups of workers achieve. In contemporary capitalism, the highest strata of workers enjoy a stable monthly salary, the middle range are paid by the hour, and the cheapest freelancers in the periphery work for a piece rate. The last is the ideal for the organisation of projects, while the first is the best for making a living. The central tenet of the social conflict around workers' control over the production process can be formulated thus: is it the workers who conform to the work, or the work which conforms to the workers? And again: how the door systems of the hackerspaces fare in this scheme?

Hack around the clock…

The classic capitalist worker wakes up to the sound of an alarm clock and hurries into the factory to punch her card with the time clock. Such a regime of control brings together bodies of workers in a predictable fashion to a common space and time in order to facilitate production. Meanwhile, under contemporary cognitive capitalism, the somewhat subversive but still very timely model of the hackerspaces works in the inverse direction. Productive individuals do not have to be woken up at the same time by machines (they will work driven by their passions all night anyway): they coordinate in real time through the door system. When eventually one ventures in to the hackerspace, she flips the switch or pushes the button and the call for work goes out through the networks of mass self-communication (in the words of Castells 2012), from chat rooms to Twitter. These signals gather the members of the hackerspace. *In the final analysis, it is not the clock which controls the worker: it is the worker who controls*

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the clock! Such regime is not predictable any more, but flexible – which enables productivity to be optimised on a fluid biopolitical level rather than on a spatio-temporal grid. Workers work when they are in the best condition to do so, and in a manner which maximises their cooperative potentials.

As Foucault (2010) attests, control societies work through the modulation of the environment, rather than using discipline and punishment to set explicit limits. As a result, highly privileged workers increasingly experience work discipline as freedom. In this light, we can conclude that door systems bring into play many of the most subtle forms of oppression that characterises contemporary capitalist regimes of accumulation. Going to the hackerspace in order to boost statistics of opening times is a glaring example. However, door systems are also liberating in a more positive sense, and in some ways exemplary, since they are the result and at the same time facilitate workers control over the means of production and self-organisation against exploitation and alienation alike.

On a larger scale, the cooperation and coordination of the hackerspaces closely resembles the structure of the network enterprise. Setting up diversely implemented yet functionally interoperable door systems is once again core to the analogy. The role of technology in constituting, maintaining and developing the hackerspaces scene as a networked infrastructure for hardware hacking and a social milieu for technology enthusiasts is rather unique. All network institutions, be them states, network enterprises or manga fan clubs, have to build, maintain and develop material infrastructures through which they coordinate the projects they are working on, and draw the lines of group memberships. However, state and market actors use formal, contractual links as the basis for such coordination, which they expect the technical medium should follow. For the same reason, such actors often outsource the implementation of technical solutions while keeping what they see as management decisions within the boundaries of the organisation. In contrast, hackerspace members like to work directly with and through technology. *Hackerspaces are interesting because their members think about social relations directly in matter, designing material infrastructures around desired social scripts without the mediation of either the law or the market.*

7. Conclusions

The research question was how participation in a flexible working space is organised through conventions and technologies in the context of large scale social

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transformations affecting workers? **In the preceding pages I tried to connect the birds-eye social history of capitalism with the organisational sociology and ethnography of hackerspaces, and these two to the post-digital archaeology of technological artifacts.** I followed three methodological steps, sometimes repeated recursively.

First, I sketched out my interpretation of the transition from the industrial capitalism to network and knowledge society, and how it transforms the daily realities of workers. It has been established that both information and communication technologies (network architectures) and the workers who operate them play a central, privileged and in some sense hegemonic role in the contemporary configuration of capitalism. Some of them exploit these possibilities to construct areas of relative autonomy such as this segment of hacker culture.

Next, I described the hackerspaces as a specific organisational formation whose very possibility of existence is tied to the analysis of the network society. In an attempt to escape social determinism, I also showed how the hackerspaces established an interactive, sometimes subversive, sometimes symbiotic relationship to their political-economical environment. I analysed the line dividing the hacker life and the professional life of individuals to learn about the interface between the hackerspaces as an organisation and the precarious-flexible labour market. The main line of argument here was that various groups of precarious and flexible workers [^flexwokers] band together in the hackerspaces for various reasons, but all in a reaction to their positioning in these matrix of transformations.

In the final move I focused on how the historical conditions and the organisational dynamics are reflected, reproduced and challenged through a concrete technological artefact. There is no doubt that technologies for the control and coordination of workers play a crucial part in the social construction of contemporary capitalism, as well as hacker scenes and organisations such as the hackerspaces. The specific case examined here was the door systems which create coherence between hackerspaces while allowing for their local conditions and competences to be fully and freely expressed through grassroots research and development carried out under the project order. I looked at the role of open standards (SpaceAPI and SpaceFED) which enable this through interoperability. Finally, I analysed the arrangement of power through asking how the door system as a time regulator and spatial boundary intervenes in the traditions and trends of work discipline regimes.

In summary, the paper explored how flexible technology workers negotiate the establishment of a shared time and space, but at the same time a communication network, where they can make common their affect (socialisation) and expertise (knowledge sharing), while simultaneously using the space and the network for their

individual work. *The research took place at the intersection of three research programmes.* One that fills the void between ethnographic case studies of digital labour and the sociological critique of cognitive capitalism by interpreting initiatives of self-programmable workers in the context of social history. Another that aims to complete the socio-ethnographic account of the hackerspaces as common infrastructures of/for peer production. And a third which asks the question of material semiotics about socio-technological innovation: how agency is distributed geographically, temporally and logically through material networks comprised of humans and non-humans? While the results are as feeble and modest as these projects are far-ranging and ambitious, they could at least show the potential of these research programmes and serve as a starting point for further investigations.

Maxigas, Budapest 2014 May-December

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